WHAT IS CLAIMED IS:

1. A roll forming apparatus for rolling a selected material around a cylindrical core, the apparatus comprising:

(a) a core support for supporting the cylindrical core, said core support having an associated core rotation means for rotating said core about a core rotation axis at a controllable rotation rate;

(b) a roll support means for supporting a plurality of forming rolls positioned to surround said core about said core rotation axis, said roll support means having a roll control means operable to both radially position said plurality of forming rolls relative to said core rotation axis and constrain said plurality of forming rolls to be equally spaced from said core rotation axis, to provide integrated adjustment of said plurality of forming rolls to control a radial dimension of a substantially symmetrical forming space defined by said plurality of forming rolls; and,

(c) a material supply means for supplying the selected material to the core at a material supply rate, said material supply means having an associated material supply control means for controlling said material supply rate.

2. The roll forming apparatus as defined in claim 1 wherein

said core support has an associated pivotal mount for pivoting said core support and the core mounted thereon about a core pivoting axis orthogonal to a longitudinal axis of said core support;

said plurality of forming rolls includes two adjacent gap rollers separated by a gap, said roll control means being further operable to

expand said gap to accommodate movement of the core into and out of said forming space, and

contract said gap to secure said core in said forming space for forming by said plurality of forming rolls; and,

when said gap is expanded, said associated pivotal mount is operable to pivot said core support into and out of said forming space.

3. The roll forming apparatus as defined in claim 2 wherein

said roll support means comprises a plurality of support arms for supporting said plurality of forming rolls, each support arm of said plurality of support arms being pivotably mounted; and,

said roll control means is operable to pivot each support arm of said plurality of support arms to expand and contract said radial dimension of said forming space, and to expand and contract said gap.

4. The roll forming apparatus as defined in claim 3 wherein

said plurality of support arms are pivotably mounted on a plurality of support pivots, each support arm of said plurality of support arms being pivotably secured by a unique associated support pivot of said plurality of support pivots and each support pivot of said plurality of support pivots being spaced at a common support arm

radius from said axis of rotation;

each forming roll of said plurality of forming rolls is mounted on a unique associated support arm of said plurality of support arms and is spaced from said unique associated support pivot for said unique associated support arm by a common roll distance; and,

said roll control means includes a support arm linking means for

constraining said plurality of support arms to pivot together about said plurality of support pivots such that said plurality of forming rolls are collectively radially adjustable by said roll control means.

5. The roll forming apparatus as defined in claim 1 further comprising an aggregate control means for integrally controlling said associated core rotation means, said roll control means, and said associated material supply control means to accommodate changing rolling conditions.

6. The roll forming apparatus as defined in claim 5 further comprising a diameter measuring means for measuring a combined diameter of the core and the selected material rolled thereon.

7. The roll forming apparatus as defined in claim 6 wherein said aggregate control means is operable to adjustably control said controllable rotation rate via said core rotation means based on

said combined diameter of the core and the selected

material received thereon as measured by said diameter measuring means; and,

said material supply rate.

8. The roll forming apparatus as defined in claim 5 wherein said roll control means is operable to control compression of the selected material on said drum by controlling said radial dimension of said forming space.

9. The roll forming apparatus as defined in claim 1 wherein said plurality of forming rolls comprises a plurality of interlocking rollers, each interlocking roller of said plurality of interlocking rollers

comprising an associated large diameter disc and an associated small diameter disc, and

having an adjacent interlocking roller in said plurality of interlocking rollers;

such that said associated large diameter disc of each interlocking roller of said plurality of interlocking rollers is offset relative to said associated large diameter disc of said adjacent interlocking to permit overlap to minimize said forming space.

10. The roll forming apparatus as defined in claim 1 wherein each roller of said plurality of forming rolls is made of nickel-plated aluminum.

11. An apparatus for receiving a selected curable material and for retaining the selected curable material

during a forming stage and a curing stage, the selected curable material being formed into a desired configuration during the forming stage and being heated during the curing stage to harden the selected material in the desired configuration, the apparatus comprising:

a core mounted for rotation about an axis of rotation, the core having

an associated core rotation means for rotating the core about an axis of rotation,

an outer permeable surface for receiving and retaining the selected curable material, and

fluid communication means for receiving air flow from the outer permeable surface;

a curing means for heating the selected curable material to at least a curing temperature to harden the selected curable material in the selected configuration; and,

a vacuum means in fluid communication with the fluid communication means of the core for

drawing a forming core air flow through the fluid communication means, the outer permeable surface of the core and the selected curable material retained on the core during forming of the selected curable material retained on the core, the forming core air flow having a temperature below the curing temperature, and

drawing a curing core air flow through the outer permeable surface and the fluid communication means of the core and the selected curable material retained on the core during curing of the selected curable material retained on the core.

12. The apparatus as defined in claim 11 wherein the curing means includes

a curing station for supplying a curing air supply around the core, and

air heating means for heating the curing air supply to at least the curing temperature; and, the vacuum means includes

a forming air outlet for receiving the forming core air flow from the fluid communication means,

a recirculation outlet for receiving the curing core air flow from the fluid communication means and for recirculating the curing core air flow back to the curing station, and

a valve means for controlling fluid communication between the forming air outlet and the fluid communication means and for controlling fluid communication between the recirculation outlet and the fluid communication means.

13. The apparatus as defined in claim 12 wherein the vacuum means includes

an exhaust fan for discharging the forming core air flow via the forming air outlet; and,

a recirculation fan for recirculating the curing core air flow to the curing station via the recirculation outlet.

14. The apparatus as defined in claim 12 wherein the valve means has

an associated forming setting, the valve means in the associated forming setting being operable to connect

the forming air outlet to the fluid communication means, and to disconnect the recirculation air outlet from the fluid communication means;

an associated curing setting, the valve means in the associated curing setting being operable to connect the recirculation air outlet to the fluid communication means, and to disconnect the forming air outlet from the fluid communication means; and,

an associated distributed setting between the associated forming setting and the associated curing setting for providing continuous air flow through the core when the apparatus is changing from the forming stage to the curing stage, the valve means being operable to decrease fluid communication between the forming air outlet and the fluid communication means and to conjointly and proportionately increase fluid communication between the recirculation air outlet and the fluid communication means when the valve means is moving through the associated distributed setting from the associated forming setting to the associated curing setting.

15. The apparatus as defined in claim 14 further comprising

a forming station for forming the selected curable material retained on the core into the selected configuration; and,

a core support for supporting the core, the core support being pivotable about a pivot axis to pivot the core between the forming station and the curing station, the core support having a vacuum conduit for providing fluid communication from the fluid communication means of

the core to the forming air outlet and the recirculation outlet, the valve means being operable to control fluid communication between the forming air outlet and the vacuum conduit and to control fluid communication between the recirculation outlet and the vacuum conduit.

16. The apparatus as defined in claim 15 wherein the curing station comprises a curing oven for receiving the core and for supplying the curing core air flow to the core, the core support being operable to pivot the core into and out of the curing oven.

17. The apparatus as defined in claim 16 wherein

the curing oven has a rear opening, a main opening and a main door for closing and opening the main opening, the main opening extending lengthwise along the curing oven and the core support being operable to pivot the core into and out of the curing oven core when the main door is open;

the core support is positioned beside the rear opening of the curing oven and has a sealing plate dimensioned to close and seal the rear opening of the curing oven when the core is pivoted into the curing oven when the main door of the oven is open, the main door being closeable when the core is in the oven to seal the core and the selected material retained thereon in the oven for curing.

18. The apparatus as defined in claim 17 wherein

the curing oven comprises a curing air inlet for

discharging the curing air supply into the curing oven, the curing air inlet being in fluid communication with the recirculation outlet; and

the air heating means is between the recirculation outlet and the curing air inlet to heat the curing air supply to at least the curing temperature.

19. The apparatus as defined in claim 18 wherein

the curing oven includes a rear door for closing the rear opening, and

the curing air inlet includes an associated bypass valve for disconnecting the curing air inlet from the curing oven and rerouting the curing air supply back to the air heating means.

20. The apparatus as defined in claim 18 wherein

the curing oven includes an oven air outlet for drawing an oven air outflow from the curing oven and for inducing a rotational air flow of the curing air supply around the core in the curing oven, the oven air outlet being in fluid communication with the air heating means and the curing air inlet to recirculate the oven air outflow back to the curing air inlet after the oven air outflow has been reheated; and,

the oven air outlet and the curing air inlet are located on a common side of the curing oven and are disposed on opposite sides of the core.

21. The apparatus as defined in claim 20 wherein the curing air inlet extends lengthwise along the common side

and releases the curing air supply along substantially an entire length of the selected curable material retained on the core.

22. A method of forming and curing a selected curable material in a desired configuration comprising:

(a) supplying the selected curable material to the core;

(b) forming the selected curable material retained on the core;

(c) curing the selected curable material retained on the core; and,

(d) during steps (a), (b) and (c), drawing a core air flow through a permeable surface of a core and through the selected curable material on the core to retain the selected curable material on the core and to compress the selected permeable material to the core, the core air flow having an air temperature below a curing temperature of the selected curable material during steps (a) and (b).

23. The method as defined in claim 22 wherein

the core air flow comprises a forming core air flow and a curing core air flow;

step (c) comprises supplying a curing air supply around the core, some of the curing air supply being drawn in through the selected curable material and the permeable surface as the curing core air flow; and,

step (d) comprises

during steps (a) and (b), drawing the forming core air flow through the permeable surface of the

core and through the selected curable material on the core,

heating the curing air temperature of the curing core air flow to at least the curing temperature of the selected curable material, and

during step (c), drawing the curing core air flow through the permeable surface of the core and through the selected curable material on the core.

24. The method as defined in claim 23 wherein step (d) comprises continuously drawing the core air flow through the core when switching the forming core air flow to the curing core air flow between steps (b) and (c).

25. The method as defined in claim 23 wherein

step (a) comprises rotating the core in a rotary direction to wind the selected curable material around the core;

step (c) comprises inducing a rotation of curing air supply in the rotary direction around the core.

J. M. Mack P. Eng — October 5th 1999

INVENTOR — DATE